

# Getting Virtualization into the Wild

## How to bring Virtualization into the Net

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## Outline

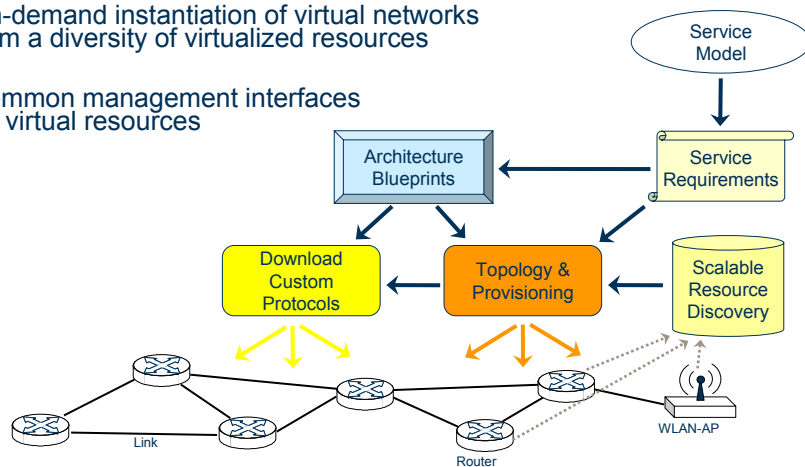
- Motivation
- 4WARD Virtualization Concepts
- Small-scale Virtualization Testbed
- Large-scale Virtualization in OneLab/PlanetLab

## Motivation

- Virtualization as key technology for the Future Internet:
  - Coexistence of different network architectures
  - Emergence of new business models
  - Better use of resources
- Many virtualization techniques already exist today, allowing intelligent access control, efficient multiplexing and dynamic resource management (e.g. ATM, MPLS, VLAN, XEN, ...)
- But no coherent framework exists to enable flexible resource management and deployment of arbitrary architectures across different providers

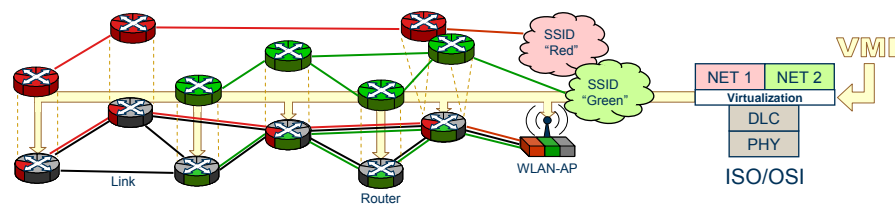
## 4WARD Virtualization Concepts

- Goal: Unified provisioning framework for virtual networks
- On-demand instantiation of virtual networks from a diversity of virtualized resources
- Common management interfaces for virtual resources



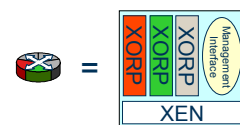
## Small-scale Virtualization Testbed

- Network virtualization from a bottom-up perspective:
  - “Basic Substrate” with physical resources like Routers, Links, Access Points, Base Stations, Spectrum, ...
  - Virtualization mechanisms to partition physical resources into virtual resources
  - “Virtualization management interfaces” (VMI) for resource provisioning and management

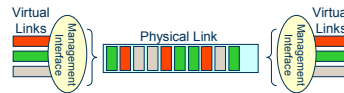


## Virtualization Mechanisms

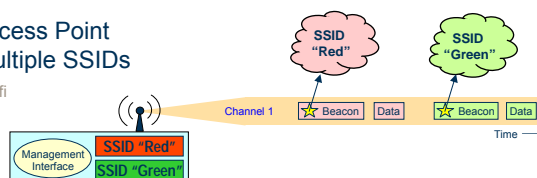
- Router: Virtual machine (e.g. XEN) + routing platform (e.g. XORP)  
 Alternatives: VMware, VServer, Click



- Links: Labeling mechanism for Ethernet frames (e.g. VLAN)  
 Alternative: MPLS



- WLAN: Configure Access Point to support multiple SSIDs  
 Alternative: MadWifi



## Small-scale Testbed Overview

**Main Menu:**

- 1) Add/Delete/List WLAN
- 2) Add/Delete/List VLAN
- 3) Add/Delete/List VRouter
- 4) Change VMI Address
- 5) Exit

Your choice: ?

- Resources: Virtual Routers, Virtual WLAN and Virtual Links
- Simple management client: remotely create, connect and destroy virtual resources for small virtual networks

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## VMI Example

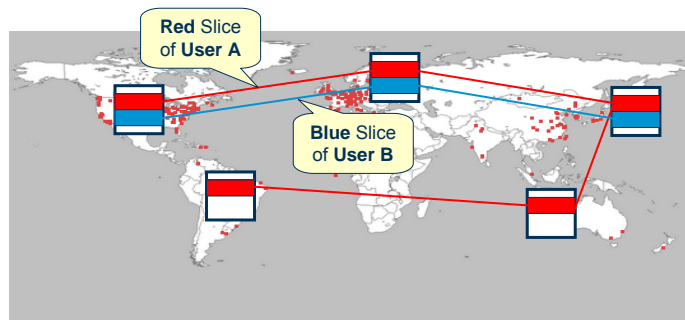
- Basic substrate: Ethernet
- Transport protocol: TCP / IPv4
- Each physical resource is managed by a „Resource Manager“
- Every Resource Manager (RM) implements a VMI
- RM-Methods can be called via VMI in an object-oriented manner
- RM has the necessary low-level knowledge to fulfill the request

- Step-by-step example for virtual routers

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## Large-scale Virtualization in PlanetLab

- Currently consists of 870 nodes at 460 sites (June 2008)
- Utilizes VServer software for OS-Level virtualization
- **Advantage:** High performance, low overhead, can serve many users
- **Problem:** Based on 1 kernel, users must share kernel resources: 1 protocol stack, 1 address space, 1 routing table, ...
- **Result:** Stuck within IP, *Network Virtualization* not possible



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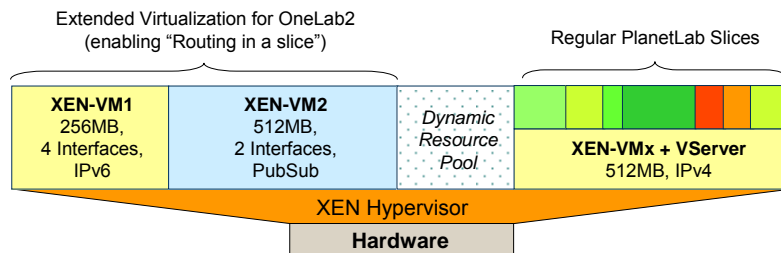
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## Extending Virtualization in OneLab2

- Keep the advantages of OS-Level virtualization (VServer)
  - Compatibility with PlanetLab
  - Remain able to serve a high number of users
- Bring in virtualization on a lower level
  - Enable users to manage their own kernel resources (e.g. routing tables and protocol stacks)
- Possible approach: Use XEN-based virtualization and place the VServer into a XEN-VM



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## Summary

- Virtualization as key technology for the Future Internet
- 4WARD is developing a comprehensive concept and framework for virtual networks
- Small-scale testbeds support the conceptual development with experimental experiences
- Goal for OneLab2: Extending PlanetLab's Virtualization capabilities
  - Roll out virtualization concepts on large scale
  - Enable OneLab/PlanetLab users to run experiments with different network/routing protocols (beyond IP)
  - Make network virtualization available to a broad community and learn from experiences with „Virtualization in the Wild“

